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is that scientific work is not economically self-supporting. Scientific men are not paid directly for the research work they do, and means must be found by which scientific work shall be supported. The fourth is closely connected with this—the need to keep science in touch with the general public, whence it must obtain its recruits and its support.

We can not therefore doubt that a national association for the advancement of science will be maintained, and that it will grow in importance and influence. It is the part of each scientific man to support the existing organization, to exercise patience when the complexity of the immediate situation does not admit of easy solution, and to do his share toward improving the conditions. Not only all scientific men, but also all those who wish well to science, should appreciate the privilege of membership in the American Association and the desirability of attending the approaching meeting at Chicago.

HISTORY OF THE FORMER STATE NATURAL HISTORY SOCIETIES OF ILLINOIS¹

THE history of scientific organization is a part, merely, of the history of scientific progress, and that is a part of the history of the progress of civilization, and especially of education; and the subject which I am to present is no exception to this rule. It is difficult to omit from even a brief abstract of the history of the Illinois natural history societies all reference to the character and status of the general movements of which they were scarcely more than by-products, and still to leave in the account enough significance to make it

¹ An address given on the occasion of a meeting called to establish the Illinois Academy of Sciences.

worthy of presentation here. Under these circumstances I shall be governed by the reflection that we are to-day looking forward and not back—that we are preparing for the future and not studying the past—and that we are hence practically interested in what has come and gone only as it may help us to bring a new thing into being in a way to secure its permanent continuance and its normal growth. There have been two state natural history societies in Illinois, one founded in 1858 and the other in 1874. The first was the result of a proposal by an entomologist, Dr. Cyrus Thomas, afterwards state entomologist of Illinois, made at a meeting of the State Teachers' Association at Bloomington in 1857. The second sprang up as a sequel to the sessions of a summer school of natural science held at the State Normal School, at Normal, and had for its first president the state geologist, A. H. Worthen, and for its first secretary the present writer, then in charge of the museum of the old society in the State Normal building.

The first society was chartered by the state legislature in 1861; held its tenth and last annual meeting in 1868; published, in 1861, Volume I., series 1, of its *Transactions* (in Volume IV. of the *Transactions* of the State Agricultural Society, and again, in a second edition, in 1862, as a separate pamphlet, a rare copy of which I hold in my hand); formed a museum of natural history which was housed in the building of the State Normal School at Normal; and held two final business meetings in Bloomington, May 26 and June 22, 1871, for the transfer of its museum to the state in accordance with a provision of law passed by the general assembly of that year. This museum, held by the State Board of Education "for the use and benefit of the state," was gradually transformed, in due time, into the present State

Laboratory of Natural History. A part of its original material is now in the possession of that institution at Urbana, a part of it belongs to the State Normal School at Normal, and the remainder is in the State Museum of Natural History, founded here in 1879, and now in charge of Professor Crook as its curator.

The officers of the society mainly responsible for its establishment and growth were its corresponding secretary, later called its general commissioner, and the curator of its museum. The former was its field agent and general manager, and the latter was the custodian of its collections. Its first corresponding secretary was C. D. Wilber, who served in that capacity until 1864. He subsequently became a mining engineer, much consulted by western railroads in the location and development of coal lands on their grants and in their neighborhoods. Its curator was for several years Dr. J. A. Sewall, instructor in chemistry in the State Normal School, at Normal, and afterwards president of the Colorado State University. Its second general commissioner, and afterwards the second curator of its museum, was Major J. W. Powell, who was in its service in the latter capacity when he made those remarkable western explorations, and especially that most remarkable expedition down the Colorado River of the West, which gave him world-wide fame and did much to make him later the United States Geologist. The third actual curator, serving, however, nominally as Major Powell's deputy, was Dr. George W. Vasey, afterwards for many years botanist to the United States Department of Agriculture at Washington; and the last to serve in this capacity was the present writer, appointed by the State Board of Education in 1872, after the state had acquired the museum, and continued as director of the State Laboratory of Nat-

ural History after the change of name and function finally made in 1879.

This society came into existence at a time so different from our own that we can derive little from its experience by way of either warning or instruction. Its period was that of the first active exploration and discovery of the scientific contents and economic resources of our territory, and of the first general impulse to the scientific education of the people; and the society was formed as an agency for a natural history survey of the state, in the old sense of an accumulation of museum specimens and a descriptive record of its zoology, botany and paleontology—meteorology and physical geography being nominally included, also, within the scope of the society. In 1858 the State Geological Survey was just getting on its feet, with Mr. Worthen appointed that year as its director. The normal school at Normal was the only state educational institution in Illinois, and that had been organized only one year. The state university was not founded until nine years thereafter, at which time, also, the state entomologist's office was first established.

Almost none of the men engaged in the work of this old society had anything approximating what we would now call a scientific education, and very few of them were what we would now call professional scientists or teachers of science, and yet they were evidently the pick of the state in scientific ability, enthusiasm and activity. Among its more efficient members, besides Powell, Vasey, Worthen and Thomas, already mentioned, were Benjamin D. Walsh, the first state entomologist; M. S. Bebb, well known for his work on the willows of the United States; Dr. Oliver Everett, of Dixon; James Shaw, of Mt. Carroll, and Dr. Henry M. Bannister, the last two assistants on the Geological Survey; Dr. J. W. Velie, a life-long ornitholo-

gist, still living in Michigan; and Dr. Frederick Brendel, of Peoria, author of many botanical papers, and also still with us, one of the very few survivors of the early membership. I must not omit, even in this briefest mention, the name of Professor J. B. Turner, of Jacksonville, first president of the society, famous in the history of the state universities because of his leadership in the pioneer movement for an industrial education of college grade; nor Dr. Edmund Andrews, of Chicago, who became one of the leading surgeons of that city; nor Newton Bateman, state superintendent of public instruction, who lent to the society the prestige of his great name—a most potent educational influence in that day.

You will wish, I am sure, to know something of the subjects in which the more prominent members were interested, and on which they wrote their papers for the society programs, and I will mention a few of them, taken at random. By Dr. Brendel: "Forests and Forest Trees of Illinois," "The Trees and Shrubs of Illinois," "The Oaks of Illinois," "Meteorology in connection with Botanical Investigations," "Additions to Robert Kennicott's Flora of Illinois." By Dr. Everett: "The Geology of a Section of Rock River Valley." By A. M. Gow, of Dixon: "Natural History in Schools." By R. H. Holder, of Bloomington: "A Catalogue of the Birds of Illinois." By James Shaw: "The Great Tornado of 1860." By Dr. Thomas: "Insects of Illinois, with Catalogue of Coleoptera," "Mammals of Illinois." These latter papers, it scarcely need be said, were extremely slight sketches of their subjects. By Dr. Vasey: "Additions to the Flora of Illinois," "The Pernicious Weeds of Illinois," "The Range of Arborescent Vegetation." By Dr. Walsh: "Insects Injurious to Vegetation in Illinois," "The Armyworm and its Insect Foes," "Insect Life

in its Relation to Agriculture." By Mr. Wilbur: "The Mastodon giganteus, its Remains in Illinois." Most of these papers were published in the *Transactions* of the State Agricultural Society, some of them also in the *Prairie Farmer*, of Chicago, those being virtually the only avenues of publication open to students of science in Illinois in that day.

The society operated through an elaborate organization of special committees of its members, one for each division of the natural history of the state, each committee composed, of course, of unpaid volunteers who were made responsible for the accumulation and preparation of material for their several departments of the museum, and for contributions on their respective divisions of its natural history. This survey work was extremely irregular in amount, and unequal in value, and its results were never organized by the society into a working collection. The curator was an instructor in the normal school, and seems to have received no pay from the society; but the general commissioner was supposed to give his entire time to its service. His salary was evidently uncertain in amount, and dependent largely on his success in securing entrance fees from new members. Financial complications arose—disputes as to ownership of property, difficulties in the payment of debts incurred, refusals to turn over to the treasurer the funds claimed by the society—and these, with other confusing and discouraging conditions, led to the withdrawal by members of gifts and deposits of specimens and a falling off in the active membership. The society finally collapsed chiefly because of its financial disabilities. Since it could neither pay adequately its general commissioner or its curator, nor organize its collections or publish its papers from its own resources, it turned to the state for aid, and found itself ultimately obliged to accept the condition

that its property should be transferred to the state, and that its curator should be appointed by a state board, as the price of continued appropriations; which, by the way, were largely drawn upon to outfit and maintain the Powell expeditions to the far west. (Fifteen hundred dollars directly appropriated by the State Board of Education.)

There is no doubt that this short-lived society brought a body of influential public opinion to the aid of state scientific and educational enterprises appearing during its existence, and that it did much to stimulate a general interest in scientific knowledge and research, and thus to hasten the introduction of the sciences into the public schools—influences which did not cease when its own organic life was ended. It also afforded to Powell the standing-ground from which he leaped into fame as an explorer, and won his way to a scientific career of the first importance, and it left in its museum nuclear collections which were later made useful in a revival and firm establishment of the original enterprise of the society, modified to suit more modern ideals, by the State Laboratory of Natural History. This first state society thus gave indirect origin to the state laboratory, with which the state entomologist's office became practically identified in 1883, much as the first geological survey of the state gave origin to our present state museum. If our new academy do no more, proportionately to its period and its environment, within the next ten years, it will amply justify our proceedings to-day.

By 1879, after an interval of eleven years from the actual dissolution of the old society, a virtually new situation had arisen in science, and especially in scientific education. Under the influence of Darwin and Agassiz and Huxley, a transforming wave of progress was sweeping through college and school, a wave whose strong upward

swing was a joy to those fortunate enough to ride on its crest, but which smothered miserably many an unfortunate whose feet were mired in marsh mud. This wave reached central Illinois in the early seventies with the effect to bring about, in 1875, a summer school of natural history at the State Normal School—only two years, it will be noticed, after the first session of the Agassiz School at Penikese. Wilder, of Cornell, and W. S. Barnard, just back from Europe with a doctor's degree, were members of its teaching staff, together with Burrill, of the State University; Thomas, the state entomologist, and the present writer, who was also director of the school. Besides an abundance of living plants and animals of our own environment, we had great boxes and barrels of marine material in large variety, some of it received alive, secured by a most active collector engaged for the purpose, who scoured the New England coast for us from Portland to Buzzard's Bay. This school was a notable success, except that the Illinois instructors all worked for nothing and paid their own expenses; but the Centennial Exposition of 1876 deranged plans for its immediate continuance. In 1878, however, a second equally successful session was held, at the close of which its students spontaneously organized themselves into a natural history society, and appointed a committee of correspondence to extend its membership and enlarge its scope. As a consequence of the numerous and unanimously favorable responses to the letters following, a conference was held at the office of the state geologist in Springfield, December 12, 1878, and the secretary of this conference was instructed to call a convention at Chicago for the organization of a state natural history society.

Some forty persons responded to the call, and organized at the Palmer House, January 16, 1879, and letters were read from

fourteen others who wished to join the proposed society. The first officers were A. H. Worthen, of Springfield, president; T. J. Burrill, of Urbana, and H. M. Bannister, of Chicago, vice-presidents; Homer N. Hibbard, of Chicago, treasurer; S. A. Forbes, secretary, and Selim H. Peabody, of Champaign, and Cyrus Thomas, of Carbondale, additional members of the executive committee. By the close of the year sixty-six members had paid their initiation fees of three dollars each.

This was the period of the return to nature in the study of science, and annual field meetings were provided for. The first of these was held at Ottawa, July 10, 1879. Dividing into three sections—geological, botanical and zoological—under the leadership of Worthen, Burrill and Forbes, respectively, the society took to the woods in the beautiful, prolific and historically interesting valley extending along the Illinois River eighteen miles from Ottawa to Peru, and with Starved Rock, Deer Park, Buffalo Rock and the site of the famous Indian village at Utica within or near its boundaries.

Annual program meetings followed at Bloomington, Springfield, Urbana, Springfield, Peoria and Jacksonville; and field meetings at Lake George, Indiana, near Chicago, where a Chicago sportsmen's club placed their club-house, premises and equipment at our disposal; at Fountain Bluff and Grand Tower, on the Mississippi in southern Illinois; at Warsaw, in Hancock County, the home of Mr. Worthen; and at Peoria, where the Peoria Scientific Association joined us in a steamer trip up the Illinois River for aquatic work. These field meetings were well attended, as a rule, and were much enjoyed, although it must be confessed that they were perhaps more agreeable than permanently profitable to us. The annual meetings also were interesting to the participants, and did some-

thing, no doubt, to stimulate the workers among us, and something also to interest and instruct the communities in which they were held. Their average character may be well enough illustrated by the program of the Urbana meeting in 1882.

The first session was devoted to an address on "Primitive Religion in America," by Mr. McAdams, of Jerseyville, which was substantially an account of the religion of the Mound Builders as inferred from idols and other implements of a religious character which had been collected by the speaker. During the next session, Dr. Edwin Evans, of Streator, read a paper on "The Rock System of the Northwest," based mainly on the records of borings for artesian wells, and illustrated by maps and colored diagrams. This was followed by a paper on "Recent Microscopy," by Professor Burrill, of the university, giving a historical account of the development of the microscope and a description of its most recent improvements and performances; and this by a paper on "Prehistoric Remains in Southeastern Missouri," by F. S. Earle, of Cobden—essentially a classification and general description of mounds studied on a trip made for the Smithsonian Institution. A lecture on "The Fossil Tracks of the Connecticut Valley," by Don Carlos Taft, professor of geology in the university; a paper on "The Army-worm in 1881," by F. M. Webster, of Waterman; and one on "The Organs of the Sixth Sense of Blind Fishes," by S. A. Forbes, completed the program of the first day, which was followed by an evening reception to the society by the faculty and students of the university, and a microscope display given jointly by the university and the society.

The program of the following day contained a paper on "Sciences in the Public Schools," by C. W. Rolfe, of the university; one by Mr. McAdams on "The Great

Cahokia Mound of Madison County," of which the writer had just completed a survey; one by Professor Burrill on "Some Vegetable Poisons," and one by Mr. Forbes on "The First Food of the White-fish." Professor N. C. Ricker, of the university, read a paper on "The 'Blue Process' of Copying by Photography," just coming into use for the duplication of papers and drawings; James Forsythe, of Champaign, gave an account of the life history of a jellyfish studied by him at Beaufort, S. C.; Dr. Evans gave a paper on "The Subterranean Waters of the Northwest"—a discussion of the origin of the artesian waters of northern Illinois and southern Wisconsin; Mr. A. B. Seymour, botanist to the State Laboratory of Natural History, read a paper on "Field Work on Parasitic Fungi"; Mr. Cyrus W. Butler, also a state laboratory assistant, gave some zoological notes from the field-book of a naturalist; J. A. Armstrong presented an abstract of the papers read at a recent meeting of the University Natural History Society; and Professor Rolfe read brief papers on "Experiments with Germinating Seeds," and on "The Rings of Wood as indicating the Growth of Trees."

In 1880 the question of an enlargement of the field of the society to include the physical and mathematical sciences came up for discussion, and was decided negatively, on the ground that the interests represented by physicists, chemists and mathematicians were so separate from those of the naturalists that a common society was not desirable—a conclusion perhaps warranted in view of the kind of naturalists that most of us were.

In 1882, when the treasurer reported a balance of \$150 in his hands and \$122 more due from members in annual fees, the question of a publication of papers and proceedings was brought forward in the secretary's report and referred to a committee;

but no steps were taken to that end on the ground that it was not desirable to multiply centers of publication unnecessarily, and that there was no lack of opportunity to publish really valuable papers in established periodicals.

Following upon these conclusions, and possibly in part because of them, the paid-up membership of the society began to decline. Indeed, of the sixty-six persons who completed their membership during the first year, thirty-nine did not continue their payments thereafter, and at the end of the second year the actual paid-up membership was fifty-two. The following year it was fifty-four, then fifty-two, then forty-three and finally, in 1884, it fell to twenty-seven. The executive committee took these facts to indicate that there was at the time no sufficiently general and urgent desire for the permanent maintenance of a society of this description to warrant its continuance, and after the Jacksonville meeting of 1885, which passed without a formal election of officers, it was not called together again.

And now I hardly need say that, after the lapse of twenty-two years of amazing progress in science and in scientific education, an entirely new situation again exists in Illinois—one so radically different from that of the early eighties that the conclusions then reached have no very important bearing on our problem of to-day. There are more college specialists here to-day from one department of one institution than there were in our whole membership in 1879. Indeed, that list is not so long that I can not give it to you now, to emphasize the contrast. It consisted of J. D. Conley, of Carlinville; T. J. Burrill, of Urbana; S. H. Peabody, of Champaign; Rev. Francis X. Shulak, of St. Ignatius College, and E. S. Bastin, of the old University of Chicago—five men, one of whom, Dr. Bastin, did not meet with us again.

Lindahl, of Rock Island, and Marcy, of the Northwestern, joined us in 1880, and Robertson, of Carlinville, in 1882, and a few additional members of the faculty of the State University paid us the compliment of an initiation fee when we held our meeting at Urbana, but went no farther with us. If there was any professional or active worker in biology or geology at any other Illinois college at the time, we never made his acquaintance nor he ours. Of the state scientific officials there were only Worthen, Thomas and Forbes. Thomas left the state in 1883, but the two others stayed with the society to the end.

It should be remembered, in this connection, that this was a time when college men, as a rule, worked like dray-horses and were paid like oxen, and the sacrifice of time and means necessary to prepare adequately for the annual and semi-annual meetings of the society, and then to attend them, was more than they could, or ought to, make, except for some really important end.

It will be seen that, under these conditions, our membership would now be almost wholly classed as amateurs. The active members of the last two years were chiefly collectors of specimens, and species-students of the old school—a few still-glowing brands from the enthusiasms of the exploration period, with scarcely a spark to testify to the coming illumination, in the midst of which it is our present privilege to live. And so the society passed, leaving no permanent material product of its work, except private collections and such papers of its members as were published here and there, as each individual thought best.

Does this account seem discouraging to our present undertaking? I do not think that it ought to; but quite the contrary. If, under such conditions, with so little material, and—as a reasonable modesty perhaps requires that I should add—under such general management, it was possible

then for us to organize a state natural history society and to keep it actively at work for seven years, we ought now, I think, with all our present comparatively immense advantages, to found a state academy of sciences which shall live and thrive at least for seventy years, and, for all that I can see, for seventy times seven—by which time we shall all have been long relieved from all our responsibilities, and the labors and the honors of scientific enterprise will have been handed on to our remote successors.

S. A. FORBES

UNIVERSITY OF ILLINOIS

MEDALS OF THE ROYAL SOCIETY¹

THE Copley medal is awarded to Professor Albert Abraham Michelson, foreign member of the Royal Society, on the ground of his experimental investigations in optics.

In 1879 Michelson brought out a determination of the velocity of light by an improved method, based on Foucault's which gave 299,980 kilometers per second. Three years later, by means of a modification of the method, capable of even greater precision, he found for this constant, of fundamental importance for electric as well as optical science, the value of 299,853 kilometers.

Michelson has been a pioneer in the construction of interferometers, which are now indispensable in optics and metrology. With his new instrument, at Paris, he determined the absolute wave-lengths of the red, green and blue lines of cadmium by counting the number of fringes (twice the number of wave-lengths) corresponding to the length of the standard meter of the Bureau International des Poids et Mesures. He found the meter to be 1,553,164 times the wave-length of the red line of cad-

¹ Concluding part of the presidential address of Lord Rayleigh—read at the anniversary meeting of the Royal Society on November 30.